ASTR 350 Introduction to Astrophysics - Stars

Syllabus, Fall 2013 — Lecturer: Matthew Baring

See `http://spacibm.rice.edu/%7Ebaring/astr350/astr350.html` for details.

1. Celestial Mechanics

1. Kepler's Laws (1609)
2. Conic Sections
3. Planetary Orbits
4. Newtonian Mechanics
   Potential and Kinetic Energies
5. Binary Orbits
6. Derivation of Kepler's Laws
   Kepler's First Law
   Kepler's Second Law
   Kepler's Third Law

2. Binary Stars, Exoplanets and the Virial Theorem

1. Binary Stars
   Mass Determination Using Visual Binaries
   Spectroscopic and Eclipsing Binaries
2. Extrasolar Planets
3. Virial Theorem

3. Tides, Comets and Asteroids

1. Tidal Forces
2. Comets
3. Asteroids

4. Photometric Concepts and Radiation

1. Magnitudes
2. Extinction and Reddening
3. Blackbody Radiation
   Wien and Stefan-Boltzmann Laws
   Planck Spectrum

5. Radiation Processes and the Quantum Atom

1. Continuum Mechanisms
   Photo-electric Effect
   Compton Scattering
   Cyclotron and Synchrotron Radiation
   Bremsstrahlung Radiation
2. Spectral Lines
   Kirchhoff's Laws
3. The Bohr Atom
4. Quantum Concepts

6. Stellar Spectra and Atmospheres

1. Spectral Classification
2. Atom Excitation: the Boltzmann Equation
3. Ionization and the Saha Equation
4. The Hertzsprung-Russell Diagram
   Morgan-Keenan Luminosity Classes
5. The Radiation Field
   Radiation Pressure
6. Stellar Opacity

7. Radiative Transfer

8. Structure of Spectral Lines

7. Stellar Structure

1. Hydrostatic Equilibrium

2. Pressure and Equation of State

3. Stellar Energy Sources
   Gravitational Potential
   Nuclear Timescales
   Thermonuclear Reaction Rates
   Thermonuclear Chains

4. Stellar Structure

8. The Sun

1. The Solar Interior
   Solar Neutrino Problem

2. The Solar Surface and Exterior
   The Solar Cycle

9. Stellar Evolution

1. Star Formation
   Gravitational Collapse: Jeans Criterion
   Pre-Main Sequence Stars

2. Evolution on the Main Sequence
   The Schönberg-Chandrasekhar Limit

3. Late Stages of Stellar Evolution
   Massive Stars

4. Supernovae
   Lightcurves of Supernovae

5. Stellar Pulsation
   Variable Stars

6. The Physics of Stellar Pulsation

10. Compact Objects

1. White Dwarfs
   Degenerate Electrons in White Dwarfs
   Mass-Radius Relation and the Chandrasekhar Limit

2. White Dwarf Cooling

3. Neutron Stars
   Neutron Star Structure
   Pulsars

4. Black Holes